Distribution Ranges and Patterns of Nonhuman Primates in Western Pando, Bolivia

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ABSTRACT. Nine species of ceboid monkeys and six species of callithricid monkeys were found to inhabit western Pando, Bolivia. The respective distribution ranges and preferences for vegetation type were elucidated. Furthermore, it was determined whether different species of primates actually existed sympatrically or not, when there was overlap in their distribution ranges. The influences which hunting pressures and breakdown of the forest exert on each primate species are discussed.

INTRODUCTION

The continuous tropical rain forest in the upper Amazon basin extends from the Río Caquetá basin in the north to the Río Madre de Dios basin in the south. The Río Caquetá and the forest in its basin represent the border of distribution of some species of primates (IZAWA, 1973; HERNANDEZ-CAMACHO & COOPER, 1976). The same is true for the Río Madre de Dios (HILL, 1957, 1960, 1962; HERSHKOVITZ, 1977). However, there have been no detailed reports yet as to whether the Río Madre de Dios is itself a barrier to the distribution of primate species.

Many species of primates inhabit the tropical forest extending from the Río Madre de Dios northwards to the Río Purus (HILL, 1957, 1960, 1962; HERSHKOVITZ, 1977). It has not been determined, however, whether the various primate species inhabit the forest sympatrically or allometrically.

Paying particular attention to these two questions, the authors studied the ranges and distribution patterns of primates in western Pando, Bolivia.

STUDY AREAS AND PERIODS

The region surveyed by the authors ranged from 11° to 12°S, and from 68.5° to 69.5° W. Inquiries were made also in its environs (Fig. 1).

During the study periods from 1st to 19th September, 1978 and from 14th June, 1979 to 5th January, 1980, intensive surveys of the primate distributions were made on foot (1) in the Río Acre basin from 11th to 24th November, 1979, (2) in the inland area between the Río Acre and the Río Tahuamanu from 4th to 17th September, 1978, (3) in the Río Tahuamanu basin from 27th July to 5th August, 1979, (4) in the Río Manuripi basin from 20th to 27th June, 1979 and (5) in the head basin of the Río Abuná from 2nd to 3rd January, 1980. The remaining days of the periods were spent on inquiring about the distributions of primates and making an ecological survey of *Callimico* at Mucden.

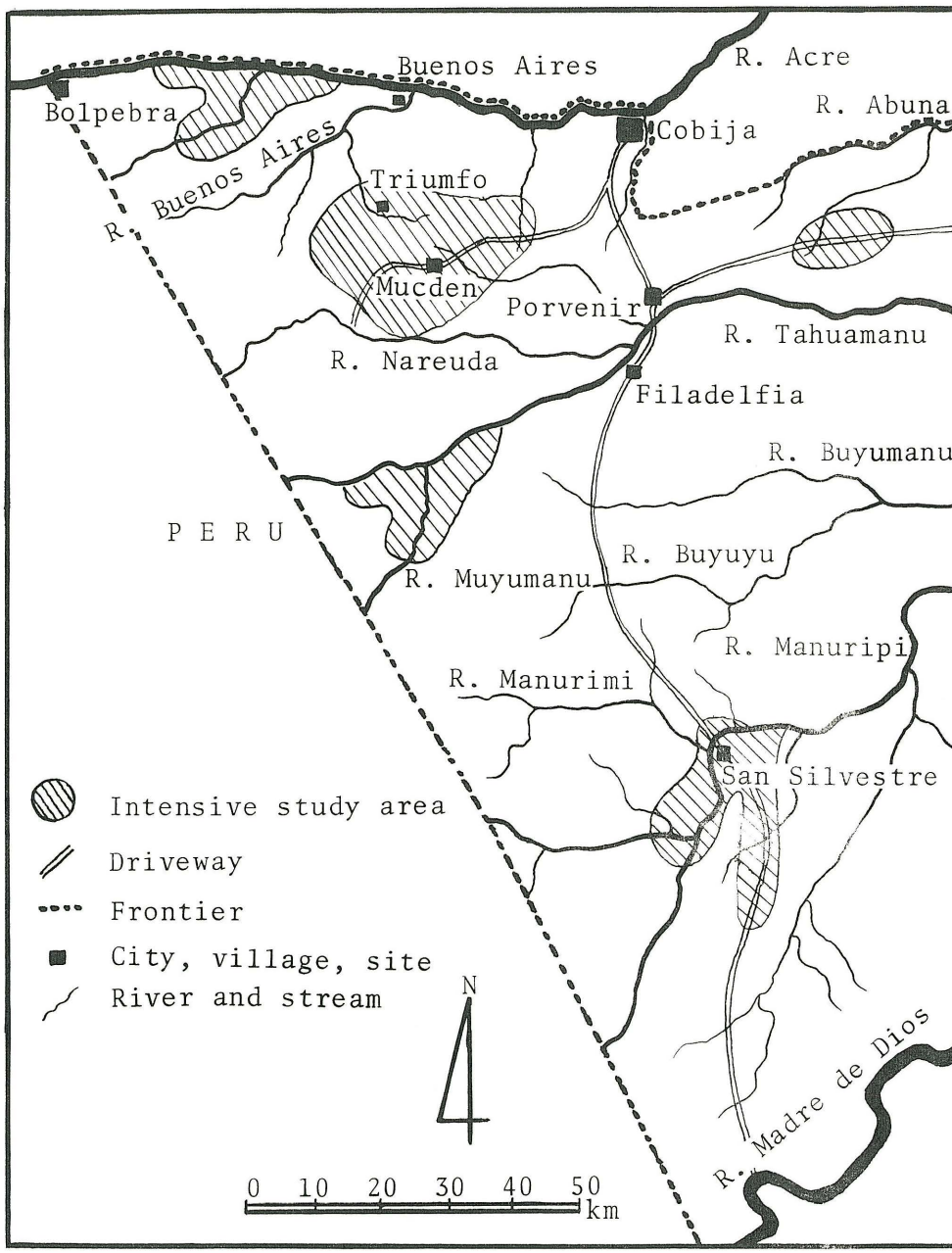

Fig. 1. Map of the study areas.

VEGETATION TYPES

It was impossible to classify the vegetation of each of the study areas precisely during the distribution surveys over such an extensive area. The authors therefore classified only the vegetation which was judged to be important from the viewpoint of the distribution ranges and patterns of the primates inhabiting western Pando.

Monte alto: Typical Amazonian and undamaged tropical forests. Stretches of tall trees formed the forest canopy with a height of about 30 m, low trees formed one or two forest layers beneath the canopy with a height of about 10–20 m, while vines, shrubs and grasses showed scanty development.

Monte bajo: Undamaged tropical forests. Stretches of tall trees did not form the forest canopy, so that low trees, bamboo thickets, vines and shrubs were well developed.

Barbecho claro: Secondary forests appeared in crop fields abandoned by shifting cultivation. A forest canopy with a height of 10–20 m was formed, so that vines, shrubs and grasses were thin.

Barbecho tupido: Secondary forests appeared as in Barbecho claro. However, a forest canopy was not formed, and bamboo thickets, vines, shrubs and grasses grew thickly.

In this region, caucho trees (*Hevea brasiliensis*) and Brazil-nut trees (*Bertholletia excelsa*) occur at high densities. Rubber and Brazil-nuts have been collected since the late 19th century. The crop fields around the houses of settlers are abandoned by shifting cultivation year by year. The secondary forests which have appeared on such abandoned crop fields occupy an appreciable proportion of the region. The reason why the authors included the secondary forests among the vegetation types was that such well developed secondary forests exert a strong influence on the distribution patterns of the primates.

RESULTS AND DISCUSSION

Distribution Ranges of Ceboid Monkeys

The ceboid monkeys which were confirmed to inhabit the study areas by direct observation or from their vocalizations included *Alouatta seniculus*, *Cebus apella*, *Cebus albifrons*, *Saimiri sciureus*, *Pithecia hirsuta*[1)], *Callicebus moloch* and *Aotus trivirgatus* (Fig. 2).

Besides these seven species of primates, *Ateles paniscus* and *Lagothrix lagothricha* were confirmed from inquiries.

Among the above nine species of primates, seven species, namely, *A. seniculus, C. apella, C. albifrons, S. sciureus, C. moloch, A. trivirgatus* and *A. paniscus*, inhabit the whole region between the Río Acre and the Río Madre de Dios and extend along the Río Madre de Dios to the south. *P. hirsuta* borders the Río Tahuamanu; it does not exist south of the Río Tahuamanu. *L. lagothricha* is found within a small limited range in the head basin of the Río Abuná.

Distribution Patterns of Ceboid Monkeys

A. paniscus is typically an inhabitant of Monte alto. The monkey must have occurred widely in the above-mentioned region, but due to hunting by rubber and Brazil-nut collectors it is almost certainly extinct in the locality between the Río Acre and the Río Tahuamanu. It appears that being larger-sized and as tasty as *L. lagothricha* and *A. seniculus*, this monkey is readily discovered and hunted in Monte alto. Once hunters have located the monkey, they can easily chase it in the relatively sparse undergrowth. The latest record of *A. paniscus* being captured between the Río Acre and the Río Tahuamanu dates from 1975, when two individ-

1) According to HERSHKOVITZ (1979b); reconfirmed by S. ANDERSON and R. PINE in 1980 (pers. comm.).

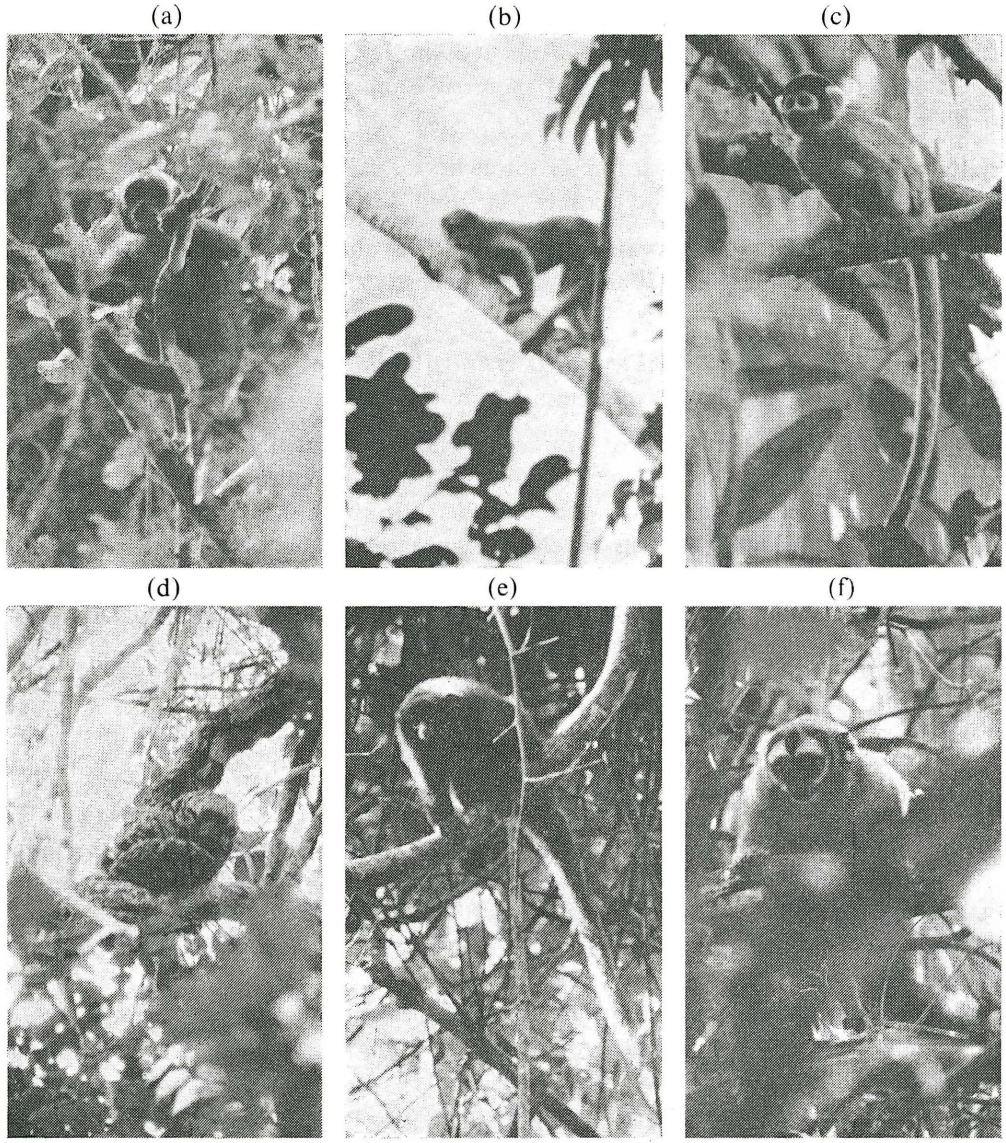

Fig. 2. Ceboid monkeys inhabiting the study region. a. *Cebus apella*; b. *Cebus albifrons*; c. *Saimiri sciureus*; d. *Pithecia hirsuta*; e. *Callicebus moloch*; f. *Aotus trivirgatus*.

uals were taken. In the locality between the Río Tahuamanu and the Río Manuripi also, this species is near extinction. Only to the south of the Río Manuripi, where few human beings live and the forest is less damaged, does this monkey occur considerably. However, the road construction between La Paz and Cobija via Ixiamas, Pto. Heath, and the related severe human impact are expected to the whole population in danger in the near future.

Like *A. paniscus*, *L. lagothricha* is typically an inhabitant of Monte alto. The distribution of the monkey, however, unlike that of *A. paniscus*, stops at the Río Abuná, one of the frontiers between Bolivia and Brazil. On the other hand, based on a reliable record that some 10–20 years ago hunters captured this species of monkey several times to the east of a line linking

Cobija and Porvenir, i.e., in the head of the Río Abuná in Bolivian territory, a small population of *L. lagothricha* must have crossed the head basin of the Río Abuná to its right bank. It is, however, sure that the monkey does not still exist in the locality in Bolivian territory.

In contrast to *A. paniscus* and *L. lagothricha*, which prefer to live in Monte alto in the inland areas, *A. seniculus* chooses to live along the rivers. Also in contrast to those two species of monkeys, *A. seniculus* inhabits not only Monte alto but also Monte bajo, and utilizes Barbecho claro. Even in the locality between the Río Acre and the Río Tahuamanu, where the hunting pressures are quite high, *A. seniculus*, by hiding itself at the tops of huge trees, maintains a relatively high population mostly in Monte alto and Monte bajo along the rivers. This monkey may be less influenced by the breakdown of the forest because it is mainly a leaf eater, and the size of its home range is smaller than that of *A. paniscus* and *L. lagothricha*, which are fruit eaters. It occurs at a higher population density to the south of the Río Tahuamanu.

C. apella inhabits each of the four types of vegetation and is one of the commonest ceboid monkeys in the region. This reflects the recent low incidence of hunting for food purposes because the natives think that *C. apella* is a reservoir of the "Tiña" (*Discromia discolor*) disease which is endemic to some Amazonian tribes of Bolivia (e.g., the Mosetene, Chimanes, Yuracarés and Tacanas) (EDMUNDSON, DEMIS & BEJARANO, 1967). Also, in spite of being a subject of hunting, *C. apella* is able to maintain a relatively high population due to its agility in behavior. Especially in Monte bajo and Barbecho, where hunting is rather difficult, the monkey forms a noticeably high population. In many cases, it lives in association with *S. sciureus*.

C. albifrons, unlike *C. apella*, prefers to live in Monte alto. The monkey occurs at a higher population density between the Río Manuripi basin and the Río Madre de Dios basin, where Monte alto broadly extends continuously. This monkey rarely forms interspecific association with *S. sciureus*.

S. sciureus, like *C. apella*, inhabits each of the four types of vegetation. However, it prefers to live in Monte bajo and Barbecho and dislike living in Monte alto in the inland areas. Not being a subject of hunting for food, although it is occasionally captured as a pet, the monkey occurs at a higher density except in Monte alto in the inland areas.

P. hirsuta is the only species of ceboid monkeys which borders the Río Tahuamanu. This monkey, which prefers to live in Monte alto and in the inland areas, is distributed in the locality between the Río Acre and the Río Tahuamanu. Although being a subject of some hunting, it maintains a relatively high population. This may be because hunters have difficulty in discovering the monkey as it lives placidly in small groups (2–6 individuals) in the tree canopies. The monkey may have enlarged its distribution from the north to the present locality. The fact that, in comparison with the Río Acre and the Río Manuripi, the Río Tahuamanu has thick flooding forests on both its banks, could be one of the reasons why this monkey has been unable to enlarge its distribution over the Río Tahuamanu. Decisive reasons why it borders the Río Tahuamanu have not been determined.

Unlike the other species of ceboid monkeys, *C. moloch* prefers to live in Monte bajo and Barbecho tupido. It also lives in Barbecho claro. When some groups of the monkey utilizes Monte alto, their main home ranges are located in Monte bajo and/or Barbecho. *C. moloch* enlarged its distribution from the south to the present locality in quite early ages (HERSHKOVITZ, 1963; IZAWA, 1980). Subsequently, Monte bajo- and Barbecho tupido-like vegetations must have formed the niches of this species. Ranking with *C. apella* and *S. sciureus*, *C. moloch*

Table 1. Number of encounters with the monkeys in the study areas*.

	Study area					No. of individuals counted (min.–max.)
	A	B	C	D	E	
Cebidae						
Alouatta seniculus	0 (4)	0 (5)	0 (6)	0 (2)	0 (0)	
Cebus apella	3 (1)	12 (2)	4 (2)	4(1)	2 (0)	2–11
Cebus albifrons	1 (1)	2 (0)	1 (0)	1 (1)	0 (1)	4–13
Pithecia hirsuta	2 (1)	4 (1)	0 (0)	0 (0)	2 (0)	1–5
Saimiri sciureus	2 (0)	3 (0)	5 (0)	3 (0)	1 (0)	3–32
Callicebus moloch	5 (3)	8 (7)	3 (1)	1 (1)	2 (1)	2–4
Aotus trivirgatus	2 (0)	0 (1)	1 (0)	0 (0)	0 (1)	1–3
Callithricidae						
Saguinus fuscicollis	9 (2)	13 (6)	11 (1)	6 (2)	4 (1)	2–11
Saguinus labiatus	5 (1)	16 (6)	0 (0)	0 (0)	5 (0)	1–13
Saguinus imperator	0 (0)	0 (0)	5 (2)	0 (0)	0 (0)	2–8
Cebuella pygmaea	2 (0)	1 (0)	4 (2)	0 (0)	0 (0)	1–5
Callimico goeldii	1 (0)	1 (0)	0 (0)	0 (0)	0 (0)	7–8

*Encounters were counted as one each when the monkeys encountered were thought to be of the same group. Numbers of vocalizations are shown in parentheses. Vocalizations were also counted as one each when they were thought to be emitted by the same group of monkeys. Study area A: right bank of the Río Acre (studied on foot in the forest for 5 days); B: inland area between the Río Acre and the Río Tahuamanu (for 12 days); C: right bank of the Río Tahuamanu (7 days); D: the Río Manuripi basin (5 days); E: the Río Abuná basin (2 days).

is a ceboid monkey which occurs at the highest population density in the locality between the Río Acre and the Río Tahuamanu. Such occurrence of maximum population density in three species of monkeys may be closely related to the fact that Barbecho develops well in the locality. *C. moloch* occasionally forms interspecific associations with *A. trivirgatus* and with *S. sciureus*; it does so with any species of callithricid monkeys.

A. trivirgatus, like *C. apella*, inhabits each type of vegetation, but prefers to live in Monte bajo and Barbecho tupido. It lives not only in Barbecho in the jungle but also in Barbecho tupido around villages. This might be favoured by its nocturnal habit, which plays a role in the avoidance of human disturbance, including hunting pressures.

Each of the nine species of ceboid monkeys in the study areas constitutes only one sub-species, and there is no evidence that two sub-species of the same species might live in the study areas with segregated ranges.

The number of encounters recorded for each of the four intensive study areas is shown in Table 1.

Distributions of Callithricid Monkeys

The callithricid monkeys which were directly confirmed to inhabit the study areas included *Saguinus labiatus*, *Saguinus fuscicollis*, *Saguinus imperator*, *Cebuella pygmaea* and *Callimico goeldii* (Fig. 3). *Saguinus mystax* was also confirmed from inquiries, and one of the authors (G.B.) saw two individuals at Cobija which had been captured near Buenos Aires (see Fig. 1).

Among the six species of monkeys confirmed, only *S. fuscicollis* is distributed in the region between the Río Acre and the Río Madre de Dios. This contrasts with the distribution of ceboid monkeys, where seven species are recorded. *S. labiatus* borders the Río Tahuamanu and there is a high possibility that *C. goeldii* also borders this river. *C. pygmaea* is distributed over the Río Tahuamanu, but probably not over the Río Manuripi. *S. imperator* inhabits

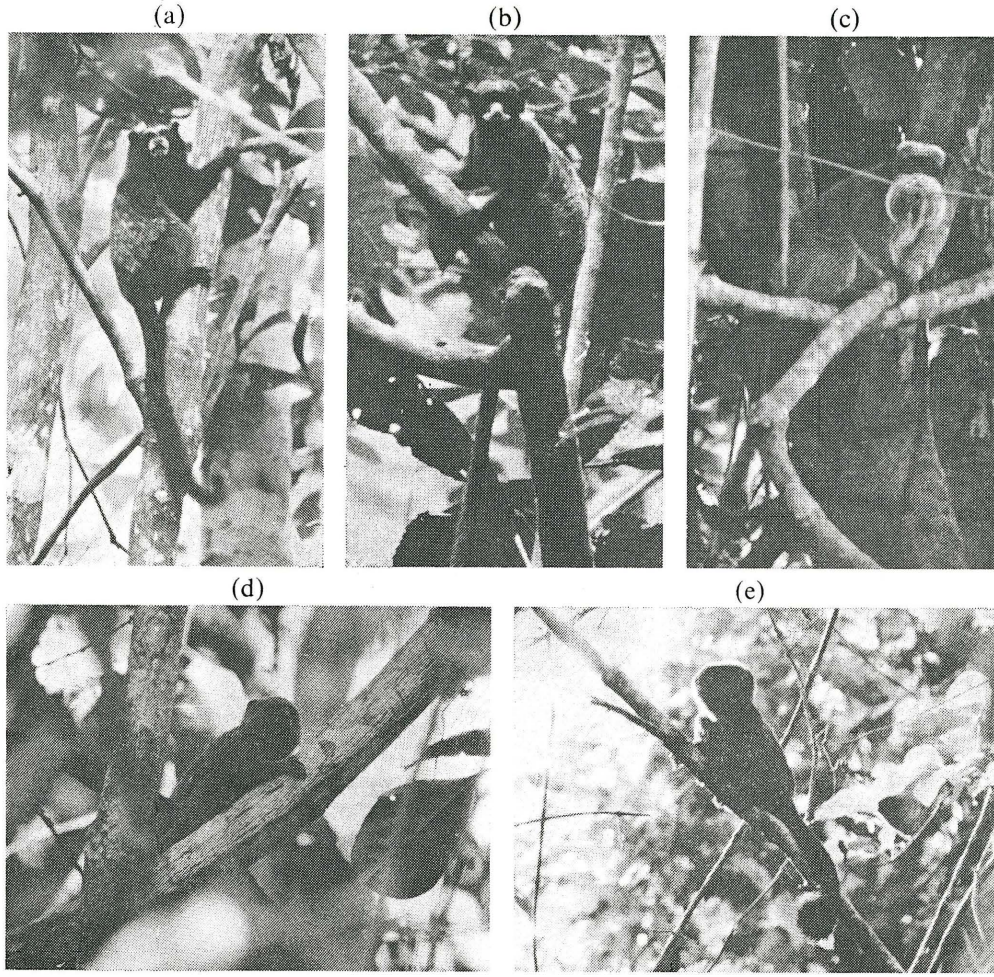

Fig. 3. Callithricid monkeys inhabiting the study region. a. *Saguinus fuscicollis weddelli*; b. *Saguinus labiatus labiatus*; c. *Saguinus imperator subgrisescens*; d. *Cebuella pygmaea*; e. *Callimico goeldii.*

only a small limited range between the Río Tahuamanu and the Río Manuripi. *S. mystax*, like *Lagothrix lagothricha*, inhabits a quite limited range in the head basin of the Río Abuná.

Distribution Patterns of Callithricid Monkeys

Of *S. fuscicollis*, *S. f. weddelli* inhabits the region. This monkey represents the most common species of callithricid monkey there and inhabits each type of vegetation as a high population. It forms associations with each of the five other species of callithricid monkeys during its daily life. It often forms associations also with one species of ceboid monkey, *Callicebus moloch*, and occasionally with *Saimiri sciureus* and *Pithecia hirsuta*. The distribution of *S. f. weddelli* extends southwards over the Río Madre de Dios.

Of *S. labiatus*, *S. l. labiatus* inhabits the present locality. This monkey also lives in each type of vegetation, but compared to *S. fuscicollis*, it prefers to live in Monte alto to Monte bajo and Barbecho tupido. It occurs at a higher population density in the inland areas be-

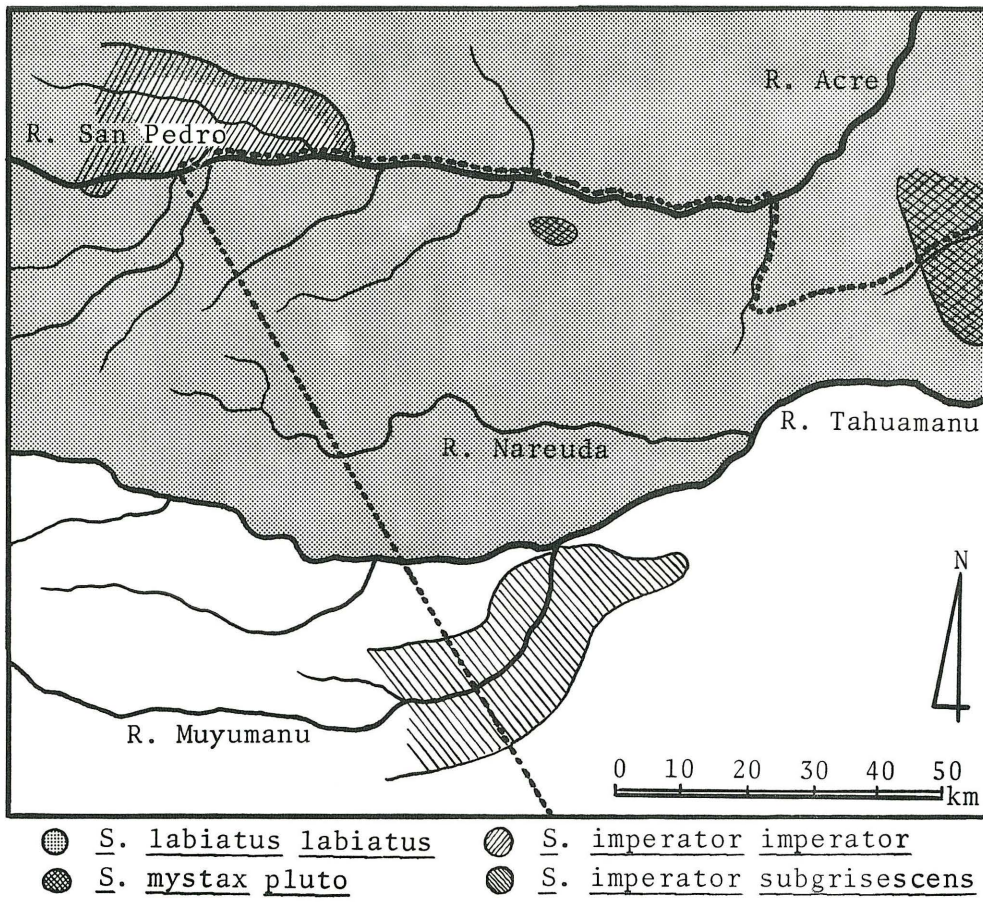

Fig. 4. Distribution ranges of *S. labiatus*, *S. imperator* and *S. mystax*.

tween the Río Acre and the Río Tahuamanu. In many cases it forms an association with *S. fuscicollis*. *S. l. labiatus* is not a subject of hunting. However, during recent years, considerable numbers of this species of monkey have been captured and exported to the United States as experimental animals for biomedical research. It remains unknown why this monkey, like *Pithecia hirsuta*, is not distributed to the south of the Río Tahuamanu. However, one reason could be that the monkey prefers not to live in thick riverine flooding forest, which differs from the typical Monte alto.

In 1977, five monkeys which were not *S. l. labiatus*, were captured on the left bank of the Río Acre (on the opposite side to Buenos Aires). Since they displayed solid dark grey coloration on the back, were red bellied, and had a larger moustache which was almost as pronounced as that of *S. mystax*, there is a possibility that they were *S. labiatus thomasi* (ANNE GALLAGHER, pers. comm.). However, the possibility also exists that they were hybrids between *S. l. labiatus* and *S. imperator imperator*, which occur in the same locality. It remains unknown what relations this monkey may have with *S. l. labiatus*.

According to HERSHKOVITZ (1979a), *S. imperator* is not distributed in Bolivia. However, the authors confirmed that *S. i. subgrisescens* inhabited only the basin of the Río Muyumanu,

which is a tributary of the Río Tahuamanu and is located to its right. The mountains undulate noticeably and bamboos and wood vines grow thickly in the Río Muyumanu basin. Here, Monte bajo forms the niches of this species of monkey. *S. i. imperator* borders the Río Acre; it does not occur in Bolivia. The monkey inhabits the riverside of the left bank of the Río Acre and the basin of the Río San Pedro, a tributary of the Río Acre. The geographical features and vegetation of these localities are quite similar to those of the Río Muyumanu basin.

S. i. imperator and *S. l. labiatus* overlap with each other on their distribution ranges on the left bank of the Río Acre. However, they are segregated, the former occurring in Monte alto and the latter in Monte bajo; they do not occur sympatrically with each other, except in a small range in the bordering area (Fig. 4). In Peruvian territory, *S. i. imperator* also exists within a small range on the right bank of the Río Acre (NAPOLEON CASTRO & FILOMENO ENCARNACÍON, pers. comm.).

Saguinus mystax borders the Río Abuná in the south (HERSHKOVITZ, 1977). However, in 1976, two individuals were captured in the forest on the right bank of the Río Acre between Cobija and Buenos Aires. Also, in a locality about 10 km northeast of Porvenir, some populations of this monkey are still found. The reason why such isolated populations of *S. mystax* occur in the present locality is presumably that this monkey, like *Lagothrix lagothricha*, enlarged its distribution by means of crossing or circumventing the head of the Río Abuná. *Saguinus mystax* is an inhabitant of Monte alto and occurs sympatrically with *S. labiatus*, which is a common species of monkey in the locality. According to inquiries, however, both never form interspecific associations with each other although they do form them with *S. fuscicollis*. Detailed ecological surveys are expected to reveal how they are segregated in Monte alto. Judging from the distribution range of *Saguinus mystax* (HERSHKOVITZ, 1977), the monkey may be *S. m. pluto*.

C. pygmaea is distributed mainly in Monte bajo and Barbecho tupido along the rivers between the Río Acre and the Río Tahuamanu. Compared to *S. fuscicollis* and *S. labiatus*, this monkey occurs at a much lower population density in the locality. It also inhabits Monte bajo in the Río Muyumanu basin, where *S. imperator* is found. It is therefore apparent that *C. pygmaea* is distributed southwards over the Río Tahuamanu. However, the authors cannot state definitely whether it has reached the Río Manuripi or not, since during the survey in the Río Manuripi basin, it was difficult to gain any decisive evidence as to whether the monkey, like *C. goeldii* also (see below), does not exist there, although actual surveying and inquiries suggested negative results.

As IZAWA (1979) has pointed out in his report, *C. goeldii*, in contrast to *C. pygmaea*, inhabits Monte bajo and Barbecho tupido in the inland areas. However, this monkey inhabits sympatrically with *C. pygmaea* in some localities. For example, on the left bank of the Río Acre, where the mountains undulate and *S. i. imperator* occurs, the monkey inhabits Monte bajo along the rivers sympatrically with *C. pygmaea*.

In comparison with *S. fuscicollis* and *S. labiatus*, C. *goeldii*, like *C. pygmaea*, exists at a much lower population density. It cannot be concluded whether *C. goeldii* borders the Río Tahuamanu, and there is no evidence either that the monkey inhabits the south of the Río Tahuamanu. Should the monkey border the Río Tahuamanu, the thick flooding forests on both its banks, which the monkey does not prefer, are probably related to its detailed distribution, as with *S. labiatus*.

Relationships Between Vegetation Types Utilized and Population Density

High hunting pressures and large-scale breakdown of the forests in this region have exerted a strong influence on the inhabitants of Monte alto, especially the larger-sized monkeys. *Ateles paniscus* and *Lagothrix lagothricha* are examples of monkeys which are subject to such influences, as are *Pithecia hirsuta* and *Cebus albifrons* to a lesser extent. *Alouatta seniculus* is influenced rather by the hunting pressures. In comparison, *Cebus apella* and *Saimiri sciureus*, which utilize each type of forest, are less subject to hunting pressures. As regards *Callicebus moloch* and *Aotus trivirgatus*, even though hunting pressures do exert some influence on them, enlargement of Barbecho tupido due to breakdown of the forest could be an advantage to them.

Callimico goeldii and *Cebuella pygmaea* enjoy more advantages than *C. moloch* since they are less influenced by the hunting pressures than *C. moloch*. This is why they are found to inhabit at exceptionally higher population densities only this region within their large distribution ranges within the upper Amazon basin (IZAWA, 1979).

Saguinus fuscicollis also enjoys more advantages than *C. apella* since this monkey is less influenced by hunting pressures than *C. apella*. *Saguinus labiatus* is probably not influenced a great deal either so long as capturing, which has been carried out for a few years, continues at the same degree as at present, although of course the number of monkeys captured will depend on the method of capturing.

In the case of *S. imperator* and *S. mystax*, unlike *S. labiatus*, should capturing be started, they might well be influenced a great deal since they form a low population and inhabit limited localities. That Monte alto changes to Barbecho would not be disadvantageous to *S. imperator*.

Acknowledgements. This study was made as part of the research project of Kyoto University, "Phylogenetical and Evolutionary Studies of New World Monkeys in South America."

The authors are indebted to the following persons for their help with the field surveys: Dr. Shiro Kondo, Chief of the project researchers, Dr. Carlos Aguirre of the National Department of Science and Technology, Bolivian Presidency, Mr. Eikichi Hayashiya of the Japanese Embassy in Bolivia and Dr. Tsunahide Shidei, Director of the Japan Monkey Centre. The authors hereby express their sincere appreciation to all these persons.

This study was supported financially by a 1979 Grant-in-Aid for Overseas Scientific Survey from the Ministry of Education, Science and Culture, Japan, and the research fund of the Japan Monkey Centre.

REFERENCES

EDMUNDSON, W. F., D. J. DEMIS & G. BEJARANO, 1967. A clinicoserologic study of pinta in the alto Beni region, Bolivia. Dermatologia Internationatis, April–June 1967.

HERNANDEZ-CAMACHO, J. & R. W. COOPER, 1976. The nonhuman primates of Colombia. In: *Neotropical Primates. Field Studies and Conservation,* R. W. THORINGTON, JR. & P. G. HELTNE (eds.), National Academy of Sciences, Washington, D.C., pp. 35–69.

HERSHKOVITZ, P., 1963. A systematic and zoogeographic account of the monkeys of the genus *Callicebus* (Cebidae) of the Amazonas and Orinoco River basins. *Mammalia*, 27: 1–79.

————, 1977. *Living New World Monkeys (Platyrrhini), Vol. 1.* Univ. of Chicago Press, Chicago.

————, 1979a. Races of the emperor tamarin *Saguinus imperator* Goeldi (Callitrichidae, Primates). *Primates*, 20: 277–287.

———, 1979b. The species of sakis, genus *Pithecia* (Cebidae, Primates), with notes on sexual dichromatism. *Folia Primatol.*, 31: 1–22.

HILL, O., 1957. *Primates, Vol. III.* Edinburgh Press, Edinburgh.

————, 1960. *Primates, Vol. IV.* Edinburgh Press, Edinburgh.
————, 1962. *Primates, Vol. V.* Edinburgh Press, Edinburgh.
IZAWA, K., 1973. The ecological study of Platyrrhine monkeys in the upper Amazon basin. Japanese Scientific Monthly, 26(7): 42–46. (in Japanese)
———, 1979. Studies on peculiar distribution pattern of *Callimico*. Kyoto Univ. Overseas Research Reports of New World Monkeys (1979), Primate Research Institute, Kyoto University, Inuyama, pp. 1–99.
————, 1980. On the evolution of Platyrrhine monkeys. *Monkey*, 24(5): 6–13. (in Japanese)

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